Experimental evidence that honeybees depress wild insect densities in a flowering crop

Supporting Information

Proceedings of the Royal Society B Biological Sciences

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Study design

The 44 experimental oilseed rape fields were situated in Scania, south Sweden in 2011 and 2012 (Figure S1). Fields were either treated with honeybee hives or used as controls, where we controlled for the absence of honeybee hives. Fields of both honeybee treatment were situated in either homogeneous or heterogeneous landscapes and sown with either open-pollinated or hybrid cultivars (Table S1).

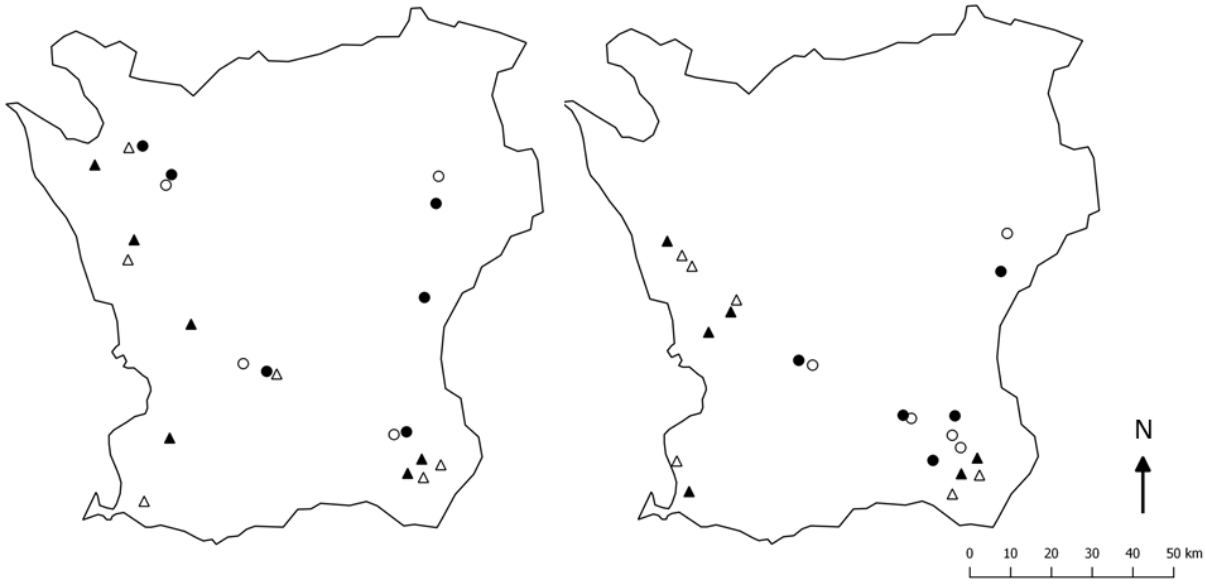

Figure S1. Field locations in the region of Scania, southern Sweden, in 2011 (left) and 2012 (right). Honeybee treated fields (filled) and control fields (open), in heterogeneous (circles) and homogenous (triangles) landscapes.

Table S1. Number of fields in the study of hybrid (H) or open pollinated (OP) cultivar type, in homogenous or heterogeneous landscape types, in the two study years and with added honeybee hives or in control fields with surroundings controlled for absence of honeybee hives.

Honeybee treatment	Honeybee fields								Control fields							
Year	2011				2012				2011				2012			
Landscape type	Simple		Complex		Simple		Complex		Simple		Complex		Simple		Complex	
Cultivar type	H	OP	H	OP	H	OP	H	OP	H	OP	H	OP	H	OP	H	OP
Number of fields	3	3	2	4	3	3	3	2	3	3	2	2	3	3	3	2

The fields were located in areas dominated by agriculture with more than 50% agricultural land within 1 km radius around fields (Table S2).

The landscape measures semi-natural grasslands and mean block area within a radius of 1 km from the centre transect were comparable between honeybee treatments (TableS2). Fields in homogeneous landscapes had smaller proportion semi-natural grasslands and larger mean block area within a radius of 1 km from the centre transect, than fields in heterogeneous landscapes (Table S2).

Honeybee densities decreased with the distance from the field edge in honeybee treated fields, but not in control fields (Table S3).

The identified species of bees, hoverflies, and marchflies, and the families of other flies are presented below (Table S4).

Table S2. Characteristics of homogeneous and heterogeneous landscapes without (C) and with (HB) added honeybee hives, within a 1000 m radius around the centre transect of each of the 44 studied oilseed rape fields.

Variables	Semi-natural grasslands of total land, %			Mean block area, ha		
	Min	Mean	Max	Min	Mean	Max
Heterogeneous landscapes						
C	3.6	9.0	12.6	4.1	6.4	9.0
HB	3.5	11.7	18.6	3.6	7.8	11.1
Homogeneous landscapes						
C	0.0	0.3	1.3	8.5	13.6	22.2
HB	0.0	0.7	2.8	7.2	17.1	33.2

Table S3. Honeybee densities in relation to honeybee treatment (HB), landscape type, year, cultivar type, standardised distance from field edge (SDIST), field size, and interactions. Effects on log-transformed mean honeybee density per 200 m^2 transect and 20 minutes in 44 oilseed rape fields analysed with a linear mixed model. Significance levels were assessed with likelihood-ratio tests. **Bold** numbers show significant factors ($p < 0.05$). When a factor or interaction was included in a higher-order interaction, no values are reported.

Variable	LR	d.f.	*p*-value
HB			
Landscape type	0.04	1	0.84
Year	**7.72**	**1**	**<0.01**
Cultivar type	1.83	1	0.18
SDIST			
Field size	0.24	1	0.62
HB × Landscape type	1.55	2	0.46
HB × SDIST	**12.64**	**1**	**<0.01**
HB × Field size	1.24	2	0.54
SDIST × Field size	0.34	2	0.84
HB × SDIST × Field size	1.61	4	0.81

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Table S4. Species of bees, hoverflies, and marchflies, and families of other flies identified in the study.

Group	Species name	Group	Family name
Bees	*Andrena caratonica*	Other flies	Agromyzidae
	A. chrysolesceles		Anthomyiidae
	A. cineraria		Calliphoridae
	A. fulva		Conopidae
	A. haemorrhoa		Dryomyzidae
	A. helvola		Empididae
	A. nigroaenea		Lauxaniidae
	A. nigrospina		Muscidae
	A. tibialis		Sarcophagidae
	B. lapidarius		Scatophagidae
	B. lucorum		Tabanidae
	B. subterraneus		
	B. sylvarum		
	B. terrestris		
	Lasioglossum calceatum		
Marchflies	*Bibo hortulans*		
	B. marci		
	B. nigriventris		
	B. varipes		
	Dilophilus borealis		
	D. febrilis		
Hoverflies	*Episyrphus balteatus*		
	Eristalis spp.		
	Eristalis. arbustorum		
	E. interrupta		
	E. intricaria		
	E. lineata		
	E. pertinax		
	E. pseudorupium		
	E. rupium		
	E. strigatus/sogdianus		
	E. tenax		
	Epistrophe elegans		
	Helophilus pendulus		
	H. trivitatus		
	Melanostoma spp.		
	M. mellinum		
	Plathycherius clypeatus		
	P. immarginatus		
	Sphaerophoria spp.		
	S. scripta		
	Syrphus spp.		
	S. ribesii		
	S. torvus		